Electronic Records for General Practice
Where we Are, Where we should Head to Improve Them

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Abstract: In this paper we present the findings of a country-wide survey that was aimed at getting a comprehensive picture of the current level of adoption and appropriation of Electronic Medical Records (EMRs) by General Practitioners (GPs). In this survey, which collected the responses from 800 Italian GPs coming from all over the country and exhibiting different experience and ICT skills, we investigated the level of current satisfaction of users with respect to two classes of functional and non-functional features of current EMRs, namely "core" and "advanced" ones. We also tried to detect which of these features are valued most highly by the current EMR users in order to inform prospective users, EMR vendors and policy makers in the eHealth domain. We also focused on the impact that digitization has had so far on General Practice, as it is perceived from the perspective of the front-line users (i.e., doctors). Finally we also addressed how the use of ICT could change in the near future as a tool to facilitate doctor patient communication and collaboration.

1 MOTIVATIONS AND BACKGROUND

General Practice is one of the professions that in the last years have been affected more deeply by a process of continuous digitization of its document- and communication-related tasks (Benson, 2002; Delaney, 2010; Dobrev et al., 2008; Purves, 1996). The Electronic Medical Record (EMR) is the main tool at the centre of this process of digitization, and therefore it has so far received the interest of hundreds of scholarly studies aimed at understanding the nature of its role in changing medical work, e.g., (Hassey, 2001; Hippisley-Cox, 2003; Porcheret et al., 2004; Treweek, 2003). For this reason, we also aim our research to get a general picture of how General Practitioners (GPs) perceive their electronic records in 2013, that is in an age when new widespread portable devices have rebuilt the concept of mobility, the Web 2.0, and the Social Media it helps spreading, have changed expectations in patients and users in general, and data exchange and interoperability have finally come of age, showing unprecedented results and reliability. In this context of new technologies in place and "old" ones that have reached full maturity and convinced even the so called "late majority" of potential users, we want to assess: their level of adoption (i.e., use); the perceived appropriation by their users (e.g., how they fit their needs), and the satisfaction of the GPs. In what follows we will then report on an attitude user study that involved a vast sample of primary care doctors and probed them on: satisfaction and usefulness of both traditional and more advanced aspects of their digitial media; the impact they believe digitization has had on their medical practice; what areas of improvement ICT designers and developers should focus on to provide them with better tools; the functionalities that they perceive as most useful; and lastly, how they currently use ICT to communicate and collaborate with their patients and how they intend to use it in the near future.
We believe that iterating this kind of initiatives on a periodic basis could allow ICT designers and policy makers to better fit the real needs of the end users involved and hence to affect quality of care, user satisfaction and ICT appropriation positively.

2 METHODS

To address the research question mentioned above,

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we focused on three main dimensions of analysis:

1. the impact of EMRs on the work of the GPs,
2. the quality perceived by GPs in regard to their EMR, and
3. the use of communication technology by GPs.

The perceived impact of EMRs on general practice has been articulated in relation to typical work dimensions, like productivity, knowledgeability, collaboration, stress and appropriateness; and also in terms of the extent ICT supports typical phases (or "concerns") of medical work, like "prevention", "examination", "diagnosis", "treatment", "follow-up" and "audit/evaluation". These latter items have been grouped in a specific construct called "QSM". The perceived quality of EMRs has been analysed in regard to three aspects: i) overall recommendability; ii) satisfaction, and iii) perceived utility. Recommendability is considered in terms of Net Promoter Score (Keiningham et al., 2007). Satisfaction has been further articulated in terms of two constructs (set of items): QSC, QSA.

The construct called "QSC" regards perceived satisfaction for those aspects (i.e., functions and attributes) that EMRs usually cover: namely "input facilitation", "personalization", "reliability", "performance", "usability", "level of integration", "adequacy of the information model".

The construct we call "QSA" regards more "advanced" functionalities: namely "support of mobility", "multiple sharing capabilities", "automatic import", "support of semi-automatic audit", "flexible back-up management", "case- and process-aware reminders", "knowledge source search and retrieval", "full record annotation".

The perceived utility of the "advanced" functions of EMRs has been expressed by a set of items encompassed by the "QUA" construct, whereas the utility of the core functionalities were given for granted. Finally, the role of ICT in mediating communication and collaboration among GPs and their patients is articulated in terms of both current use and desired prospective use, in order to see how ICT could affect the interaction between GPs and their patients also in the near future.

In August 2013, we administered a questionnaire reflecting the information model described above to a selected sample of Italian GPs, whose addresses were indexed in the mailing list of the "Federazione Italiana Medici di Medicina Generale" (FIMMG). The FIMMG is a trade union organization and country-wide professional association that represents almost 30,000 General Practitioners in Italy. With the collaboration of the Study Center of this association, we contacted 14,478 potential respondents by sending them one single message of invitation by e-mail. In this message we invited the recipients to participate in the online survey on a voluntary and anonymous basis, with no incentives nor reminders, once the main aims of the research had been outlined. Responses were collected for 5 weeks through an online questionnaire platform, Limesurvey v. 2.0. We configured this platform to have it display the questionnaire as a sequence of six short Web pages that enabled a Computer-Assisted Self Interview (CASI). In these pages, we kept the number of mandatory fields to a minimum to only allow for the conditional routing of items, so that the overall interview could take a shorter time on the basis of the responses provided in the process. The platform also allowed for unique and restricted access to the questionnaire, so that no multiple responses were collected, and only invited subjects could participate in the survey until we closed it. The platform also enabled data persistence across multiple user sessions to allow respondents to quit the questionnaire anytime and resume it at a later time. In doing so, we aimed to minimize the risk of fatigue bias: nevertheless, the pilot sessions by which we tested the survey with a small convenience panel before the invitation had been dispatched took between 8 and 12 minutes on average to complete.

3 RESULTS

At the end of the survey, we collected 800 complete questionnaires. Respondents (77% men and 23% women) were those who accepted to participate in the interview mentioned above and filled in all the items reported in the questionnaire. Partial questionnaires were then discarded. The relatively low response rate was also due to a technical problem that occurred in the dispatch of the invitation letter, which caused many letters be erroneously categorized as spam by aggressive filters, and to the fact that the survey was administered when many practitioners were likely on a summer vacation.

The average age of the respondents was 57 years (sd: 6 yrs, range: 27 – 70 yrs, 95% c.i.: 56.5 – 57.3) and 86% of the sample declared an age between 50 and 65 years. 91% of respondents claimed to have more than 10 years of experience in the GP field, and 73% more than 20 years. 85% of the sample declared to assist more than 1000 patients (22% even more than 1500; average number of patients: 1290 ± 340). These data make us confident to have collected the opinions and attitudes of experts of

great experience and deep knowledge of their application domain.

Italian macro Regions were represented in the sample with a slight preponderance of Northern Regions with respect to actual distributions of Italian GPs (North: 49% vs. 43%, Centre: 20% vs. 21%, South: 32 vs. 36%). Thus, we weighted our sample in order to make the sample representative at geographical level. Margin of error is 3.4% at National level (at a confidence level of 95%). The detected margin is consistent with conservative assumptions on response distribution, since the research *does not* claim census-like aims, but rather it aims to detect attitudes and trends in EMR use and its perceived quality. This makes our study relevant to build a picture of current EMR adoption and satisfaction and to be considered by the scientific community of IT researchers for the aims mentioned in Section 1.

In regard to IT use, 98% claimed to be using an Electronic Medical Record. This is consistent with other similar recent surveys, e.g., (Cabitza, 2012) (Misericordia, 2011). However, among the users that claimed to be using an EMR, the proportion of those who claimed to be exploiting their record only "for a small part of its potential" and, anyway, "less than actually felt necessary" is (still) high (see Figure 1, topmost diagrams): in either cases, approximately 1 GP out of 4. This is in line with the concerns discussed in (Cabitza, 2012) regarding the phenomenon of "low use"(Simon et al., 2009), and the related efforts to pay to improve user adoption and appropriation (our model addresses these points in two specific items, called PerceivedExploitation and PerceivedFit). The 94% of the sample found their EMR listed in the questionnaire, which reported 15 applications from the Italian market. Three applications were used by nearly the two thirds of the sample: we will call them Application A (used by 45% of respondents), B (12%) and C (11,8%) for sake of confidentiality.

Figure 1 depicts other characteristics of the respondent sample, in particular with regard to declared familiarity with IT (Perceived Skills), and to what kind of cooperative relationships GPs are involved in their practice (Collaboration Type): this latter information is relevant with respect to the granularity of the "sharing" functionality discussed in the QSA and QUA constructs of the model.

All of the aggregated constructs mentioned above showed very high internal consistency in terms of intraclass correlation: satisfaction in regard to support of medical dimensions (QSM, Cronbah's alpha=0.89, c.i.= .88-.90, mean scale=18, sd=4.4);

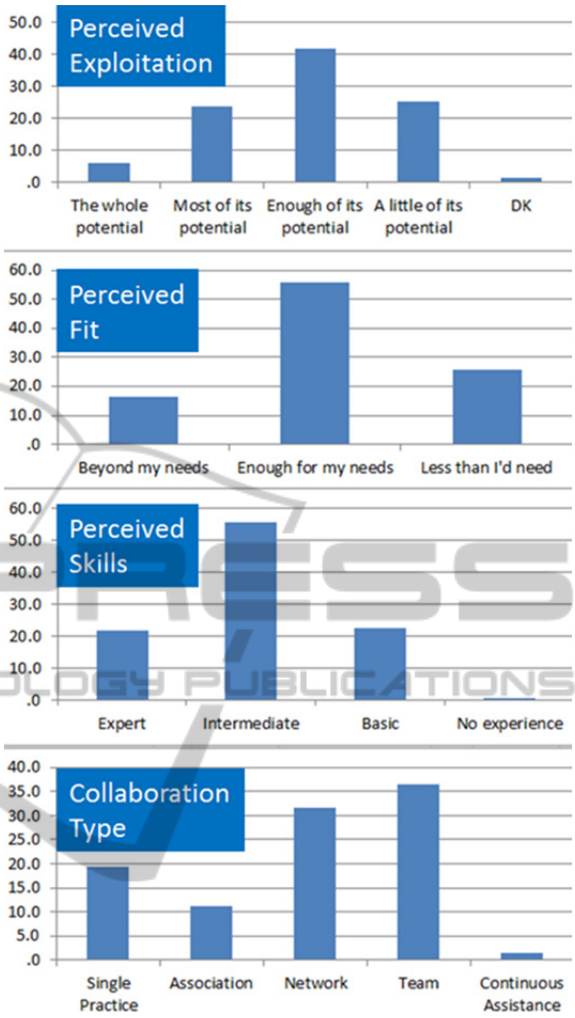

Figure 1: Descriptive statistics of the respondent sample.

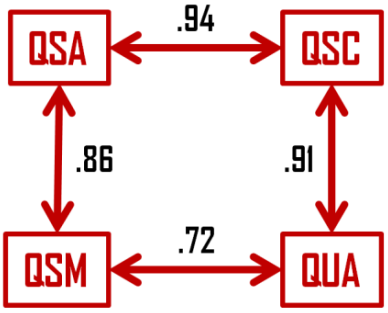

Figure 2: Inter-construct correlations.

satisfaction for common functions (QSC, Cronbah's alpha=0.84, c.i.=.82-.85, scale mean=16, sd=3.9); satisfaction for advanced functions (QSA, alpha=.92, c.i.=.87-.96, scale mean=40, sd=13); perceived utility for advanced functions (QUA, alpha=.98, c.i.=.96-.99, scale mean=49, sd=16),

perceived impact on work dimensions (PIW, alpha=.79, c.i.=.76-.81, mean=28, sd=4.2). Canonical correlations between constructs were significant between QSC and QSA (alpha=.94), QSC and QUA (=.91), QSM and QSA (.86). Correlations between QSM and QSC, and between QSM and QUA are slightly below the conventional significance threshold (.63 and .72 respectively). Figure 2 shows these inter-construct correlations in graphical form. In what follows we report the main findings for each construct of analysis.

3.1 Recommendability

As anticipated above, in regard to overall recommendability we adopted the Net promoter Score (NPS). This is a convenient way to represent satisfaction for a product as this score relates satisfaction to the pragmatic behaviour of their users and associated likelihood to recommend such a product to colleagues and acquaintances. The overall NPS of the EMRs was +13%; this means that promoters, i.e., who would highly recommend her application responding either "9" or "10" on a 1-to-10 scale, were 13% more numerous than detractors, i.e., who would not recommend her application (and responded with a mark below "6"). Nevertheless, situation differs according to the application actually owned. Just to limit ourselves to the three most used EMRs (A, B and C mentioned above), the NPS of A was +35% (i.e., the proportion of potential promoters was one third larger than the proportion of potential detractors), C's NPS was +11%, and B's one was -30% (i.e., the proportion of potential detractors was one third larger than the proportion of potential promoters). Moreover, if we assimilate the NPS 10-point ordinal scale to an interval scale, we could evaluate an "overall recommendability" score of current Italian EMRs in terms of "average score", that is 7.6 (± 2). In regard to the most used EMRs, the average score is 8.2 for A, 6.4 for B, and 7.6 for C (the difference between the scores of A and B is highly significant, t=2.9, P=.004). The Net Promoter Score of the most widely adopted EMR (45%) resulted to be highly affected by self-perceived IT skills (P-value<.001, the higher the skills, the higher the NPS), perceived level of exploitation (P-value<.001, the higher the level, the higher the NPS) and, notably, the number of patients (P=.001, the higher the number of patients, the higher the NPS); also geographic and collaboration-related differences could have an impact (respectively, P=.07 and P=.09) but this is not statistically significant; other factors, like gender, age and years of experience result not related to NP scores.

3.2 Satisfaction for Common Features

For sake of clarity, we report the results for the QSC construct with the aid of Figure 3. There we depict the response distribution for the question expressed as follows: "in regard to each feature would you please indicate the extent your current EMR should be still improved to really please you". Available options ranged on an four item scale, encompassing the labels "still a lot of room for improvement" (1), "some room for improvement" (2), "already adequate" (3), and "already optimal" (4). Boxplots show the interquartile range for perceived satisfaction: the dark green box indicates the upper quartile; the light green box the lower quartile; thus, the median is depicted as the border line between the two quartile boxes (if visible); whiskers indicate the variability outside the upper and lower quartiles (i.e., the min and max value respectively). Moreover, as a merely illustrative addition, we also indicate the response average with a small red dash, and the mode (i.e., the response chosen by the majority of respondents) with a blue dash.

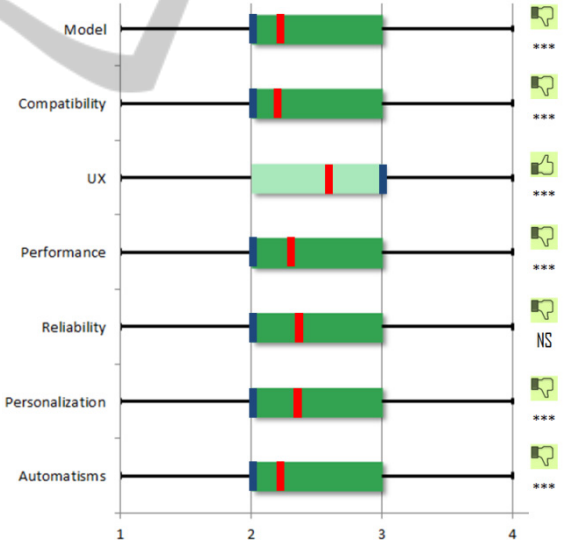

Figure 3: Box plots showing the interquartile range for QSC.

In the topmost part of Figure 3, we also show the result of a Binomial test that we undertook to understand whether the apparent tendency that can be detected for each item visually is also "true" and generalizable to the whole population of reference, or it is not so because, e.g., that tendency is due to chance. The little hand-shaped icons indicate whether the respondents were sufficiently satisfied

with the corresponding feature (i.e., responses associated with at least an "adequate" level of satisfaction) or not (i.e., responses either below or at the threshold of satisfaction, that is 2). The number of asterisks indicates how much "significant" the indication is according to the Binomial test. According to the results, then, the GPs indicated clearly that current EMRs *should be improved* with respect to:

1) their capability to make simple tasks more automatic, like offering more precompiled fields in form templates, the capability to duplicate data between fields when applicable, and more user-friendly import and export functionalities.
2) their capability to be customized by end-users, both in terms of user interface (appearance, what fields and where to position them, available formats) and functional configurability.
3) their performance, both in terms of speed in processing data and in reacting to user commands and interactions.
4) their compatibility with data coming from different applications and their interoperability with other systems and services, also at Regional level.
5) the adequacy of the information model by which patient cases and illness trajectories are represented in the electronic record (on this problem, the interested reader can refer to (Swinglehurst et al., 2012)).

Respondents also expressed the need to improve the reliability of their EMR, in terms of either absence of errors and failures. Quite surprisingly, respondents claimed they are already satisfied with the usability of the graphical interface and the overall user experience, which conversely is a common place of user dissatisfaction.

It is worthy of note the fact that both the perceived fit of EMRs with the GPs' needs and the perceived level of exploitation seem strongly correlated with the degree of satisfaction for several functions. Other contextual aspects seem to play a less important role as factors influencing satisfaction, except the number of patients treated by the single GP: the higher this number, the higher the satisfaction with respect to usability and the information model.

3.3 Perception of Advanced Features

Advanced features have been investigated both in terms of actual satisfaction (QSA) and perceived usefulness (QUA).

In regard to satisfaction for a specific feature, this was assessed on an ordinal scale of 6 items, from 1 (totally unsatisfied) to +6 (totally satisfied). Quite surprisingly, the GPs involved in our study expressed a generally higher appreciation for the advanced features than for the core functionalities (represented in the previous construct, QSC). It is as if car drivers showed appreciation for the luxury accessories of their cars (e.g., the leather-trimmed interiors), but expressed discontent for the car's reliability and its low compatibility with regular petrol stations. More seriously this could be related to the high experience of the respondents involved, probably aware of what can really produce value in their professions (on which they are demanding in reason) and what is fine but somehow superfluous.

Like in the case of the QSC construct, we verified QSA trends performing a Binomial test for each feature, by comparing the proportions of responses that were either above or below the satisfaction "threshold" (+3). Respondents claimed to be already satisfied in regard to the support of mobility, the content sharing with colleagues (other GPs), the capability to execute audits on the basis of their own patient data, to perform backup, to set proactive reminders, and to annotate their records. On the other hand, the data analysis could not detect a clear satisfaction for the capability to share data with patients, and to import data from other systems. A clear unsatisfaction could not be proved significant with respect to the capability to share information with colleagues of the "continuous assistance" program (CA, a sort of "out of hour" medical services) and colleagues other than GPs (e.g., specialists, hospital doctors). On the other hand, significant unsatisfaction has been expressed for the service by which to retrieve the latest scientific sources (usually journal articles) from the specialist literature that are pertinent to specific patient cases.

As mentioned above, the construct called QUA regards the perception of usefulness by the sample and it is expressed in terms of items whose possible answer options were represented on a six-value ordinal scale, from 1 "useless at all" to 6 "very useful". We intend this construct as an informal but consensus-based indication of what functionalities should be addressed first by EMR vendors, and therefore should be added to the portfolio of services already available in modern EMRs. It is worth of note the fact that while satisfaction for a feature was an item that had been answered only by those that had previously claimed to use an EMR already

endowed with such a feature, the usefulness of a feature was probed on the entire sample of respondents, irrespective of the presence of such feature in the respondent's EMR.

Table 1: QUA ranking.

Rank	Functionality	Priority
1	Importing	First ***
2	Backup	First ***
3	Reminder	First ***
4	Mobility	First ***
5	SharingCA	First ***
6	SharingGPs	First ***
7	SharingColleagues	First ***
8	Audit	First ***
9	PubRetrieval	First ***
10	Annotation	First ***
11	SharingPatients	First ***

As an aid to decision making and the process of detecting risks and opportunities of either developing from scratch or evolving specific features, we also performed a ranking of the features on the basis of the ordinal values collected in our survey. Table 1 shows the result of this task that we performed applying an original ranking method purposely developed to infer what features are valued most by the respondent sample. In this method priority levels were assigned to single features in the following manner: 1) we counted the number of times each feature was ranked either first, second or third ("first priority class"), or was ranked in any other position ("second priority class"); and 2) we assigned each feature to the priority level with the highest number of occurrences. This assignment was then tested with a Chi-squared test to check if rankings could be due to chance and hence fail to show a real difference in the frequency of assignment to either the first or second class of priority. As shown in Table 1, all features are to be considered in the first priority class with a very high confidence that this assignment is not due to chance. However, the evaluations collected in our study allows us to provide a ranking where data importing capabilities, backup services and reminders are the functions valued most highly, while the capabilities of annotating any content in the EMR and to share it with patients are those valued less.

3.4 Impact on Medical Work

Impact of ICT on medical work has been investigated both in terms of quality of support of specific steps of the medical process (QSM), and as perceived change in known attributes of general practice. Support quality was evaluated on a 5-value ordinal scale, ranging from 1 ("very low quality of support") to 5 ("very high quality of support"). Hence, for QSM the descriptive and inference analyses are depicted in Figure 4. From this Figure, it is clear that Diagnosis and Therapy are placed at the opposite sides of the satisfaction spectrum: GPs found "treatment" be managed properly by their EMR, probably tapping in the vast amount of research around order entry and drug prescription; while they find support of diagnosis significantly disappointing. Also the part of EMRs that covers medical examinations and sign/symptom evaluation is found to be an area that would benefit from efforts towards improvement, e.g., like those envisioned in (Cabitza et al., 2013).

In regard to the impact of EMR on GPs' work, this is clearly perceived as greatly more documented, more informed, more documented, more interesting and, most notably, much more appropriate. This is the opinion of approximately 9 GPs out of 10, except for the dimension of "interest": in this case, 1 out of 6 GPs believes that digitization has not changed the extent her work is interesting; consequently, a lower number of GPs deemed that their work has become more interesting since the advent and diffusion of EMRs (76%). Moreover, the majority of respondents indicated that their work has become more stressful; however, this finding is not associated with statistical significance (43% more stressful, 41% less stressful; 17% unvaried, Chi-squared=.62, df=1, P-value=.43, NS). In regard to privacy concerns, the majority of the respondents perceived their work as confidential as it was before digitization (more confidential 39%, vs. equal 43%, Chi-squared= .95, df=1, P-value=.33, NS). This is an interesting finding especially in light of the importance that usually IT researchers and developers attach to the requirements of security, privacy and confidentiality in the management of health data. It would be interesting to investigate if this perception of GPs is more related to a motivated confidence in their tools, or rather to an actual ignorance of the potential risks related to the management and transmission of digital data.

3.5 Use of ICT to Communicate

In regard to the role of technology in mediating doctor-patient communication, phone resulted the communication means most frequently used: 95% of the sample said to rely on phone to communicate with patients at least "sometimes and with some regularity" (79% said to do it often). Electronic mail

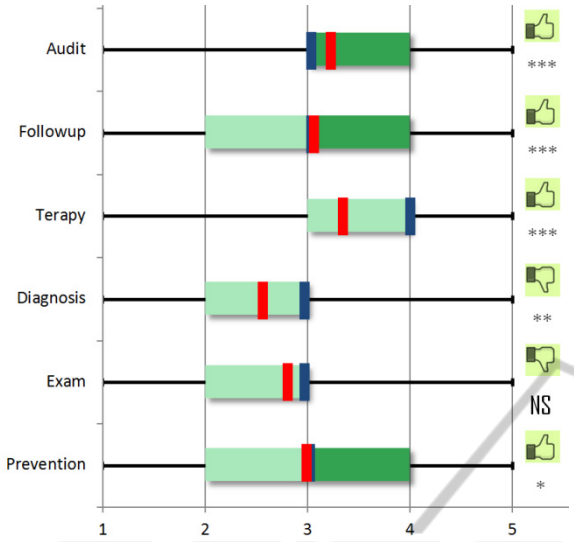

Figure 4: Boxplots for the QSM items.

is the second tool in terms of frequency of use (52% use it with some regularity, 19% often). Then SMS (32% regularly, 9% often), fax (24% regularly, 4.9% often); and finally (not surprisingly) Social Media. This term was denoted in the questionnaire as any of the following tools: Forum, Blogs, Chat and Social Networks (like Facebook and LinkedIn); interestingly, it resulted that these media are used regularly by almost one tenth of the sample (9.8%, 2.8% often). In particular, 83% of the respondents claimed to use emails to communicate with patients, while almost 1 GP out of 5 (19%) claimed to use any of the social media defined above. The frequency of use of emails, social media and SMS resulted to be correlated with statistical significance (Email with SMS, large correlation: alpha=.53, P-value<.001; Email with Social Media, moderate correlation: a=.36, P-value<.001; Social media with SMS moderate correlation: a=.39, P-value<.001). The use of Social media and emails to interact with patients was slightly correlated with claimed IT skills: the higher the latter ones, the more frequently these tools were used (for both items, Alpha=.18, P-value<.001).

When we asked the respondents about how they would like to communicate with patients in the future (obviously besides face-to-face encounters), the majority of the sample declared to be fine with current use of phone, fax, SMS and social media (more precisely, phone: 63%, P-value<.001; fax: 54%, P=0.016; SMS: 54%, P=.048; Social Media: 45%, P-values are for Chi squared tests, with 1 degree of freedom, two-tailed). However, almost one third (31%) of the respondents wished they could use phone less frequently, and similar results hold also for fax (39%), SMS (28%) and, notably, also in regard to a relatively novel means like social media (38%), which has apparently disappointed some expectations, at least as facilitator of doctor-patient interaction. Interestingly, in regard to electronic mail the results are opposite: only one respondent out of 10 expressed the wish to use emails less in the future; indeed, the majority of respondents said they would like to use emails more often in the future (49%); the difference with respect to those who are fine with current use (40%) is statistically significant (Chi squared=7.2, df=1, P-value=.007). This finding would suggest that doctors would prefer to move from a distributed voice-based interaction with patients to a message-based interaction, that is that they dread interruptions and volatile indications more than the work overload implied by having to respond to more emails from their patients, probably also in virtue of the famous proverb "spoken words fly away, written words remain".

In 2011 the same question was asked to a representative random sample of Italian GPs in a survey reported in (Cabitza, 2012). Comparing the present survey and the previous one, we observe that in 2013 a greater proportion of doctors claimed to exchange emails with their patients to discuss health-related problems "often and regularly" (11% vs. 19%); this difference is statistically significant (Chi-squared = 7.9, df = 1, P-value = 0.003). In this two-year time span, also the use of Social Media proved to have improved (14% vs. 19%, Chi-squared= 2.7, df = 1, P-value = 0.0495). Also with respect to prospective use, we detected statistically significant increases in the proportions of GPs who claim to want to use emails and social media more often: in regard to emails we observed an increase from the 30% of 2011 to the 49% of 2013 (Chi-squared =27, df = 1, P-value < .001); and in regard to social media from the 12% of 2011 to the 17% of 2013 (Chi-squared=3.1, df = 1, P-value = 0.038).

4 CONCLUSIONS

In this paper we have presented the findings of a country-wide survey about the current and prospective use by GPs of the ICTs (mostly EMRs) that support their daily practice. The vast number of GPs involved, the items considered and the analysis of the responses collected in this study make this research valuable for a number of aims. First to get a picture of the level of adoption and appropriation of EMRs in General Practice: the latter dimension was

addressed by two specific items, PerceivedFit and PerceivedExploitation, and their influence on satisfaction was proved to be relevant. Second, to begin considering analytically how multiple quality dimensions and appropriation are intertwined, and discover, for instance, how investments in IT training and IT skill improvement for GPs could be reflected in higher exploitation rates, better fit of EMRs with the GPs' needs and higher satisfaction. Last but not least, to detect areas of improvement (see Figure 4) and to assign priorities and rankings to features in order to both increase overall user satisfaction (see the NP score mentioned in Section 2.1) and decide where to focus on to make EMRs better tools (see Table 1). Notably, our survey also addresses how relatively new media could impact practice: to this regard, attempts to include current social media in medical practice by innovators and early adopters (10% of the target population) seem related to growing scepticism and disillusion. However, GPs seem to still value written interaction with their patients (cf. the increasing trends for email actual usage and intention to use), and this could hint at more communication-oriented models for the next EMRs to come, as argued in (Cabitza and Gesso, 2014)

In a period of fast and continuous innovation and yet urgent spending limits to welfare and primary healthcare, detecting the most value-adding features of a class of applications for their reference key users, and enabling the subsequent prioritization of interventions to focus on could be a necessary move to make ehealth a convincing driver for the feasible progress of the medical profession.

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